DESCRIPTION

PILE FABRIC AND METHOD FOR PRODUCING THE SAME

Technical Field

The present invention relates to a pile fabric composed of a ground structure portion and a cut pile portion, and to a method for producing the same. In more detail, the present invention relates to a pile fabric having moderately inclined portions on the surface of the cut pile portion and giving a rich high grade sense, and to a method for producing the same.

Background Art

Hitherto, pile fabrics have been used in the fields of vehicle interior materials, interior materials, clothes and the like as central fields. In recent years, pile fabrics having three-dimensional patterns on their surfaces among such the pile fabrics have been noted as pile fabrics giving rich high grade senses. As methods for forming such the three-dimensional patterns, methods for physically forming concaves and convexes and methods for chemically forming the concaves and the convexes have been known.

As the method for physically forming the concaves and the convexes, a method for embossing by the contact pressure of a sculptured roll under heating at a high temperature (for example, embossing processing, Schreiner processing) has been known, but there have been a problem that the hardening of a hand and the flattening of the fabric are highly enlarged, because the fabric is inserted between heating rolls under a heavy load, and a problem that metallic luster is developed with the heating rolls to cause a thermal discoloration.

On the other hand, as the methods for chemically forming the concaves and the convexes, a method for printing an alkali agent consisting mainly of sodium hydroxide and dissolving the printed portions to form a concave-convex difference (a step-wise difference in level) (for example, see Patent document 1), or a method for spraying an inorganic or organic solvent as a fiber-shrinking agent on a pile fabric to shrink cut piles, thereby forming the deep sharp uneven pattern (for example, see Patent document 2) have

been proposed. However, it could not have been said that the pile fabric having the stepwise concave-convex difference and the pile fabric having the deep sharp uneven pattern are satisfactory at the point of the high grade sense. In addition, the method for spraying the fiber-shrinking agent on the pile fabric has had a problem that a nozzle portion is clogged and a problem that a computer-controlled special spraying device is needed, because the fiber-shrinking agent is usually highly viscous.

[Patent document 1] : JP-B 2-35075 (JP-B means "Japanese Examined Patent Publication").

[Patent document 2] : JP-A 10-298863 (JP-A means "Japanese Unexamined Patent Publication")

Disclosure of Invention

The object of the present invention is to provide a pile fabric giving a rich high grade sense and a method for producing the same. The above-mentioned object can be achieved by the pile fabric of the present invention and the method for producing the same.

The pile fabric of the present invention is a pile fabric composed of a ground structure portion having a knitted or woven structure comprising organic fiber yarns and a cut pile portion comprising polyester-based yarns, characterized in that the height of the cut pile portion is gradually reduced to form inclined portions having inclination angles of 0.5 to 10 degree, respectively, in one or more partial regions of the above-mentioned cut pile portion.

Herein, it is preferable that two or more kinds of cut piles having mutually different brightness and / or mutually different hues, respectively, are contained in the above-mentioned cut pile portion to gradually change the color along the slopes of the inclined portions.

Also, it is preferable that a depth difference between the maximum cut pile portion height and the minimum cut pile portion height in each of the above-mentioned inclined portions is in a range of 0.6 to 1.0 mm.

Also, its is preferable that a plurality of the inclined portions are formed in the cut pile portion and a pattern is formed with a plurality of the inclined portions.

In the pile fabric of the present invention, it is preferable that the number of fine concaves having areas of not less than 0.05 mm^2, respectively, is not more than 120 fine concaves / cm^2 in the maximum cut pile portion height side 40 % region of each of the above-mentioned inclined portions.

Further, it is preferable that the total area of the fine concaves having areas of not less than 0.05 mm^2, respectively, in the maximum cut pile portion height side 40 % region is not more than 20 % based on the total area of the above-mentioned 40 % region.

It is preferable that color printing is applied to the pile fabric of the present invention.

The pile fabric of the present invention can be obtained by a method for producing the pile fabric, characterized by partially removing the cut pile portion of the pile fabric composed of a ground structure portion having a knitted or woven structure comprising organic fiber yarns and a cut pile portion comprising polyester-based yarns, by a chemical etching method, to gradually reduce the height of the cut pile portion, thereby forming inclined portions having inclination angles of 0.5 to 10 degree, respectively.

Therein, it is preferable that two or more kinds of cut piles having mutually different cut pile heights, respectively, are contained in the cut pile portion, before the cut pile portion is partially removed by a chemical etching method, and the cut piles have mutually different brightness and / or mutually different hues, respectively.

Also, it is preferable that a rotary screen having portions where the diameters of etching treating liquid-discharging holes are gradually increased is used, when the cut pile portion is partially removed by the chemical etching method.

Therein, it is preferable that two to five rotary screens are sequentially put on the cut pile portion and used to apply the chemical etching treatment.

Brief Description of Drawings

Fig. 1 is an explanatory view for typically showing a state that an inclined portion 1 is formed in the cut pile portion, in the pile fabric of the present invention.

Fig. 2 is an explanatory view for typically showing another embodiment, in the pile fabric of the present invention.

Fig. 3 is an explanatory view for typically showing a state that non-inclined steps are formed in a pile portion, in a conventional pile fabric.

Fig. 4 is an explanatory view for explaining the cut pile portion height L of the cut pile portion, in the pile fabric of the present invention.

Fig. 5 is an example of pattern capable of being formed with a plurality of the inclined portions, in the pile fabric of the present invention.

Best Mode for Carrying Out the Invention

The pile fabric of the present invention comprises (A) a ground structure portion having a knitted or woven structure comprising organic fiber yarns and (B) a cut pile portion comprising polyester-based yarns, wherein the above-mentioned cut pile portion comprises a plurality of cut piles knitted or woven in the above-mentioned ground structure portion and extended from at least one side of the above-mentioned ground structure portion.

The above-mentioned cut pile portion is composed of the cut piles comprising the polyester fibers. The cut piles constituting the cut pile portion may be one kind or more kinds. Also, the cut piles may be two or more kinds, and may have mutually different cut pile heights, brightness, hues, and the like. Such the cut piles may be conventional crimped cut piles or non-crimped cut piles. Additionally, the cut pile portion may be composed of the crimped cut piles and the non-crimped piles. It is preferable that the crimped cut piles are contained in the cut pile portion, because the lodging resistance of the cut piles is improved. A method for imparting the crimps includes a false-twisting and crimping method, an air jet processing method, and a compression-crimping method.

The polyester resin for forming the above-mentioned cut piles is

produced from a dicarboxylic acid component and a diglycol component. It is preferable that terephthalic acid is mainly used as the dicarboxylic acid component, and it is also preferable that one or more alkylene glycols selected from ethylene glycol, trimethylene glycol and tetramethylene glycol are mainly used as the diglycol component. Additionally, the polyester resin may contain the third component except the above-mentioned dicarboxylic acid component and the above-mentioned glycol component. As said third component, used can be one or more of a cationic dye-dyeable anionic component, such as sodium sulfoisophthatic acid; a dicarboxylic acid except the terephthalic acid, such as isophthalic acid, naphthalene dicarboxylic acid, adipic acid, sebacic acid; and a glycol compound except the alkylene glycol, such as diethylene glycol, polyethylene glycol, bisphenol A, biphenol sulfone.

Such the polyester resin may, if necessary, contain one or more of a matting agent (titanium dioxide), a micropore-forming agent (a metal organic sulfonate), an anti-coloring agent, a thermal stabilizer, a flame retardant (antimony trioxide), a fluorescent brightening agent, a colored pigment, an antistatic agent (a metal sulfonate), a moisture absorbent (a polyoxyalkylene glycol), an anti-microbial agent, and other inorganic particles.

The single fiber fineness (count) of the polyester fibers, the total fineness (count) of the yarn comprising one or more kinds of the polyester fibers and used for forming the cut pile portion, and the like are not limited, but it is preferable that the single fiber fineness is 0.5 to 5 dtex or that the total fineness of the yarn for forming the cut pile portion is 30 to 300 dtex. When the single fiber fineness is less than 0.1 dtex, the obtained lodging resistance is often insufficient, and the hand of the obtained cut pile portion is often excessively soft. When the single fiber fineness exceeds 10 dtex, the hand of the obtained cut pile portion is often excessively hard. In addition, when the total fineness of the yarns for forming the cut pile portion is less than 30 dtex or adversely larger than 300 dtex, caused is often a trouble wherein handleability on fiber processing such as crimping processing or blending with other yarns or on fiber knitting or weaving is deteriorated. The cross-sectional shape of the single fiber is not limited, but the single fiber may have a triangular, flat, constricted flat, cruciate, hexa-lobar, or

hollow cross-sectional shape, in addition to an ordinary circular cross-sectional shape. The yarns for forming the cut pile portion may be composite yarns each comprising two or more constituting yarns, wherein the polyester resins for the constituting yarns may be different from each other or kneaded with one or more colorants to give different colors or differently dyeing properties.

In the pile fabric of the present invention, inclined portions 1 are formed by gradually reducing the height L of the cut pile portion in one or more portion areas of the pile portion, as typically shown in Fig. 1. Such the inclined portions are obtained by removing the tip portions of the polyester-based cut piles constituting cut pile portion. By forming the inclined portions in the cut pile portion, the high portions of the cut pile portion appear to have a light color, while the low portions of the cut pile portion are shaded and appear to have a deep color. Further, since the color is changed from the light color to the deep color along the slope, a high grade sense is obtained.

Herein, it is important that the inclination angle A of said inclined portions is in a range of 0.5 to 10 degree (preferably 1 to 3 degree). When said inclination angle A is a larger acute angle than 10 degree, a satisfactory high grade sense is liable to be not obtained, because brightness is sharply changed from a light color to a deep color. On the other hand, when said inclination angle A is smaller than 0.5 degree, the brightness is sufficiently not changed, and the satisfactory high grade sense is liable to be still not obtained. As typically shown in Fig. 3, a case wherein unevenness having slope-free steps is formed in the cut pile portion is also not preferable, because a high grade sense is not obtained. Therein, it is preferable that two or more kinds of cut piles having mutually different brightness and / or mutually different hues are contained in the above-mentioned cut pile portion to gradually change the colors, as shown in Fig. 2, because an especially excellent high grade sense is obtained.

Also, it is preferable on the acquisition of a satisfactory high grade sense that a depth difference H between the maximum cut pile portion height and the minimum cut pile portion height of the inclined portion in the above-mentioned inclined portion is in a range of 0.6 to 1.0 mm. Also, it is

preferable on the acquisition of the satisfactory high grade sense that the maximum cut pile portion height L of the cut pile portion is in a range of 1 to 5 mm (more preferably 1.5 to 3 mm). When the cut piles are inclined to the ground structure portion (less than 90 degree), the cut pile portion height L of the cut pile portion is obtained by measuring a vertical distance as shown in Fig. 4.

In the above-mentioned inclined portion, it is preferable that fine concaves and fine convexes are little on the surface (inclined surface) of the inclined portion. When the surface of the inclined portion little has the fine concaves and the fine convexes and is smooth, brightness is gradually changed from a light color (the maximum pile height side) to a deep color (the minimum pile height side) along the slope. Therefore, a satisfactory high grade sense is obtained. It is preferable that the number of the fine concaves having areas of not less than 0.05 mm^2 is not more than 120 concaves / cm^2 (more preferably, 10 to 100 concaves / cm^2) in the maximum height side 40 % region of the inclined portion, as a standard of the fewness of the fine concaves. Especially, it is more preferable that the total area of said concaves is not more than 20 % (more preferably 2 to 10 %) based on the total area of the above-mentioned 40 % range. Such the smooth slope little having the fine concaves can be obtained by sequentially putting a plurality of rotary screens on the cut pile portion and performing etching treatments as mentioned later. Herein, the maximum height side 40 % region of the inclined portion is the inclined portion surface area of the region corresponding to 0.4 W in Fig. 1.

In addition, it is also preferable that a plurality of the inclined portions are formed in the partial regions of the cut pile portion to totally form a pattern with the inclined portions, because the high grade sense is further enhanced. Such the pattern includes a pattern wherein squares (it is proper that the length of one side of each square is about 1 to 3 cm) are continued on a plane as exemplified in Fig. 5, a pattern of repeated dots, a chequered, and a checkerd pattern. Therein, the light color portions in Fig. 5 are the higher places of the cut pile portion, while the deep color portions are the lower places of the cut pile portions.

The knitted or woven structure of the pile fabric of the present

invention is not limited, and is a cut pile fabric obtained by cutting loop piles, such as a warp pile woven fabric, a weft pile woven fabric, a sinker pile knitted fabric, a Raschel pile knitted fabric, or a tricot pile knitted fabric.

In the pile fabric of the present invention, the kind of yarns used in the ground structure portion, the kind of the fibers, single fiber fineness and total fineness are especially not limited, and organic fiber yarns used in ordinary pile fabrics can be used. Such the organic fiber yarns include cotton, wool, linen, viscose rayon fibers, polyester fibers, nylon fibers, polyolefin fibers, and cellulose acetate fibers. It is preferable that yarns for the ground structure portion of the pile fabric of the present invention are selected from polyester multifilament yarns, whereby the ground structure portion having good hand and good dyeability can be obtained.

It is preferable that the distribution of the cut piles in the cut pile portion of the pile fabric of the present invention is in the range of 34,000 to 220,000 dtex / cm^2. When the density of the cut piles is less than 34,000 dtex / cm^2, the cut piles in the cut pile portion are liable to easily lodge on an etching treatment to unstabilize the etching action. When the density of the cut piles inversely exceeds 220,000 dtex / cm^2, the permeability of an alkali treating liquid into the cut pile portion on the etching treatment is liable to be deteriorated to disable a satisfactory etching treatment.

The pile fabric of the present invention can be produced, for example, by the following method.

First, a pile fabric composed of a ground structure portion having a knitted or woven structure comprising the above-mentioned organic fiber yarns and a loop pile portion comprising the above-mentioned polyester-based fibers is produced, and the loop piles of said fabric are subsequently cut by an ordinary method to produce the pile fabric.

Therein, the cut piles constituting the cut pile portion may comprise one kind of cut piles, but preferably comprise two or more kinds of cut piles having mutually different cut pile heights and mutually different brightness and / or mutually different hues. When many kinds of the cut piles having the mutually different cut pile heights and the mutually different colors are thus contained in the cut pile portions, an especially excellent high grade sense is obtained, because the colors are gradually changed along the slopes

of the inclined portions on the formation of the inclined portions. For example, when a cut pile portion is composed of colorless (while) cut piles having a large cut pile height and colored cut piles having a small cut pile height, and then subjected to an etching treatment to form inclined portions, the high cut pile portions are looked to be white, while the low cut pile portions are looked to be colored. Furthermore, the color is gradually changed from the white to the color along the slopes. Thereby, a high grade sense is obtained. Also, when cut piles having a middle cut pile height between the cut pile height of the high cut piles and the cut pile height of the low cut piles are contained, and dyed in another color, the changes of the many colors are obtained. Thus, the high grade sense is further improved.

Therein, a method for obtaining the cut piles having the mutually different heights includes a method comprising using two or more kinds of yarns having different shrinkages in boiling water as yarns for the cut piles to form the cut pile portion and then thermally treating the formed cut pile portion, when the pile knitted or woven fabric is produced, and a method comprising using bended yarns prepared by simultaneously paralleling and bending non-crimped yarns and crimped yarns to form the cut pile portion having inclination angles of 5 to 10 degree, and then developing crimps in the cut pile portion.

Subsequently, the cut pile portion of said pile fabric is partially removed by a chemical etching method to gradually reduce the height of the cut pile portion, thereby forming the inclined portions. Therefore, the pile fabric of the present invention can easily be produced.

Herein, when the cut pile portion is partially removed by the chemical etching method, it is preferable to use a rotary screen having a portion wherein the diameters of etching treatment liquid-discharging holes are gradually enlarged. A plurality of holes for discharging the etching treatment liquid are formed in the surface of the rotary screen, and there is at least a portion where the diameters of the discharging holes are gradually enlarged. Since a large amount of the etching treatment liquid is discharged from the discharging holes having the large hole diameters, the cut pile portion is deeply etched to reduce the height of the pile portion. On the other hand, since only a small amount of the etching treatment liquid is

discharged from the discharging holes having the small hole diameters, the cut pile portion is shallowly etched. Consequently, the slopes can be formed in one or more portion regions of the above-mentioned cut pile portion.

Also, when a pattern is formed in the cut pile portion by an etching method, it is needed to arrange discharging holes in said rotary screen in a pattern state corresponding to the pattern. For example, when such a pattern comprising squares continued on a plane as exemplified in Fig. 4 is formed, it is needed that discharging holes are arranged in a pattern state corresponding to the pattern.

It is preferable that the number of the above-mentioned rotary screens is 2 to 5. On slopes formed with the first rotary screen, the second rotary screen and the other rotary screens are sequentially used to repeatedly apply the etching treatments, thereby obtaining such the smooth slopes little having fine concaves and fine convexes as mentioned above. The sufficient number of the rotary screens is five, but six or more rotary screens are liable to enhance the cost.

About 50 to 90 rows / 2.54 cm are suitable as the discharging hole arrangement density of the above-mentioned rotary screen in both the warp and weft directions. It is preferable that a discharging amount from the rotary screen is in a range of 15 to 25 cm^3 / m^2. When said discharging amount is more than 25 cm^3 / m^2, the alkali-treating agent is liable to cause clogging. Adversely, when said discharging amount is less than 15 cm^3 / m^2, the alkali-treating agent is liable to unevenly adhere, when adhered to the cut pile portion.

In the above-mentioned rotary screens, the number and / or arrangement of the discharging holes may be identical or different. For example, the discharging number and / or arrangement of the discharging holes of the second rotary screen may be changed, so that a slope is formed in the cut pile portion with the first rotary screen and then the minimum height side of the slope is again etched with the second rotary screen. Similarly, the discharging numbers and / or arrangements of the discharging holes of the third rotary screen and the following rotary screens may be changed, so that only the minimum height side of the slope is repeatedly etched.

The kind of the above-mentioned alkali-treating agent is especially

not limited, but a printing paste comprising 30 to 70 percent by weight of a 30 % sodium hydroxide liquid alkali and 70 to 30 percent by weight of an undiluted paste having a solid content of 15 % and used for etching, and having a viscosity of 400 to 800 poises (for example, Seruparu 587, produced by Adachi Senryo (Ltd.)) is suitably exemplified.

A known color printing (for example, an ink jet type printing disclosed in JP-A 2000-345483) or a conventional dyeing finishing processing may be applied to the pile fabric obtained thus. Furthermore, various processing treatments for imparting the functions of a conventional waterproof processing, ultraviolet light screening or anti-microbial agent, a deodorant, an insecticide, a luminous agent, a retroreflector, a minus ion-producing agent and the like may added and applied.

Examples

Subsequently, Examples and Comparative Examples of the present invention will be explained in more detail hereafter, but the present invention is not limited to these. Therein, measurement items in Examples were measured by the following methods.

Boiling water shrinkage

A counter wheel having a circumferential length of 1.125 m was rotated on a sample ten revolutions to make a skein, and the skein was hung from a hanging nail of a scale plate. A load of 1/30 based on the total weight of the skein was hung from the lower portion of the skein, and the length L1 of the untreated skein was read. Then, the load was detached, and the skein was put in a cotton bag and then immersed in boiling water for 30 minutes. Subsequently, the skein was taken out, dehydrated with filter paper, dried in air for 24 hours, and then again hung from the hanging nail of the scale plate. The same load as mentioned above was hung from the lower portion, and the length L2 of the treated skein was read. The boiling water shrinkage (BWS) was calculated from the following expression. Herein, the number of n was 5, and the average value was calculated.

$$BWS\ (\%) = (L1-L2) / L1 \times 100$$

Percentage crimp

A counter wheel having a circumferential length of 1.125 m was used to make a skein having a total fineness of 3333 dtex, and the skein was hung from a hanging nail of a scale plate. An initial load of 6g and a load of 600g were hung from the lower portion of the skein, and the length L0 of the skein was read. Then, the load was detached, and the skein was separated from scale plate and immersed in boiling water for 30 minutes to develop the crimps. Subsequently, the skein was taken out, dehydrated with filter paper, dried in air for 24 hours, and then again hung on the scale plate. The above-mentioned load was hung from the lower portion, and the length L1 of the treated skein was read one minute later. Then, the load was quickly detached and the length L2 of the skein was lead one minute later. The percentage crimp was calculated from the following expression. Herein, the number of n was 5, and the average value was calculated.

$$\text{Percentage crimp (\%)} = (L1\text{-}L2) / L0 \times 100$$

Inclination angle A

A 5 cm × 5 cm long square sample was cut in the longitudinal direction and in the latitudinal direction to the length direction of the fabric, and an inclination angle A (degree) between a horizontal direction and an inclination direction from the highest top portion of the cut pile portion to the alkali-treated lowest portion was measured with a digital microscope VHX manufactured by Keyence (Ltd.). Herein, the number of n was 5, and the average value was determined.

Depth difference H

A 5 cm × 5 cm long square sample was cut in the longitudinal direction and in the latitudinal direction to the length direction of the fabric, and a depth H (mm) from the highest top portion of the cut pile portion to the alkali-treated lowest portion was measured with a digital microscope VHX manufactured by Keyence (Ltd.). Herein, the number of n was 5, and the average value was determined.

Length W of inclined portion

A 5 cm × 5 cm long square sample was cut in the longitudinal direction and in the latitudinal direction to the length direction of the fabric, and a length W (mm) of an inclined portion shown in Fig. 1 was measured with a digital microscope VHX manufactured by Keyence (Ltd.). Herein,

the number of n was 5, and the average value was determined.

(6) Number and ratio of concaves per unit area of inclined portion

With a scanning electron microscope SX-40 manufactured by Akashi Beam Technology (Ltd.), the number (concaves / cm^2) of concaves having areas of not less than 0.05 mm^2 in the maximum height side 40 % area of the inclined portion was measured as the number of the concaves. Further, the ratio (%) of the concaves was calculated from the following expression. Herein, the number of n was 5, and the average value was determined.

Ratio (%) of concaves = (total area of concaves having areas of not less than 0.05 mm^2) / (area of maximum height side 40 % area of inclined portion) × 100

High grade sense

The high grade sense was classified into the following grades and evaluated by three testers.

Grade 5 : especially excellent at the point of the high grade sense.

Grade 4 : excellent at the point of the high grade sense.

Grade 3 : somewhat good at the point of the high grade sense.

Grade 2 : somewhat dissatisfactory at the point of the high grade sense.

Grade 1 : defective at the point of the high grade sense.

[Example 1]

A polyester filament mixed yarn (yarn count : 140 dtex / 96 filaments) prepared by air-blending a usual polyethylene terephthalate multifilament yarn (yarn count : 56 dtex / 24 filaments, boiling water shrinkage : 10 %, produced by Teijin Fiber (Ltd.)) with a usual polyethylene terephthalate false-twisted crimped yarn (yarn count : 84 dtex / 72 filaments, percentage crimp : 25 %, produced by Teijin Fiber (Ltd.)) by use of a known interlace nozzle was used as a yarn for the cut piles of a pile fabric. While, a usual polyethylene terephthalate filament yarn (yarn count : 56 dtex / 24 filaments; produced by Teijin Fiber (Ltd.)) was used as a yarn for forming a ground structure. These filament yarns were fed into all of the reeds of a 28 gauge tricot warp knitting machine (manufactured by Carl Mayer Corp.) and then knitted in the following knitted structure to obtain the pile knitted fabric having a knit density of 69 courses / 2.54 cm and 28 wales / 2.54 cm.

Ground structure : back half structure (a knitting method comprising back : 23 / 20 and front : 10 / 12).

The obtained knitted fabric was dyed by use of a jet dyeing machine manufactured by (Ltd.) Hisaka Seisakusho at 130℃ for 30 minutes. After dyed, the knitted fabric was subjected to conventional preliminary treatments (full cut raising → shearing → splitting → shearing → presetting) to obtain the pile fabric (cut pile density : 97217 dtex / cm^2) having cut piles (cut pile length : 2 mm) and a knit density of 64 courses / 2.54 cm and 35 wales / 2.54 cm.

In the cut pile fabric, the cut piles having a large cut pile height were formed from the polyethylene terephthalate multifilament yarns, and the cut piles having a small cut pile height were formed from the polyethylene terephthalate false-twisted crimped yarns.

On the other hand, prepared was an alkali-treating agent having a viscosity of 600 poises and comprising 54 percent by weight of a 30 % sodium hydroxide liquid alkali and 46 percent by weight of an undiluted paste used for etching and having a solid content of 15 % (for example, Seruparu 587, produced by Adachi Senryo (Ltd.)).

Subsequently, three rotary screens (manufactured by Takagi Cyoukoku (Ltd.)) each having the below-mentioned discharging holes and a discharging quantity of 20.0 cm^3 / m^2 were used to form inclined portions in a pattern shown in Fig. 5 (deep color portions were deeply etched) in the cut pile portion of the above-mentioned pile fabric. Therein, etching sites with the three rotary screens were overlapped. In said pattern formed in the cut pile portion, the length of one side of a square as a base unit was 1 cm.

(Discharging holes)

Arrangement density : 70 rows / 2.54 cm in both the longitudinal and latitudinal directions.

In response to the pattern shown in Fig. 5, the discharging holes were distributed (the discharging holes having the largest hole diameters were arranged at positions corresponding to the deepest color portions, and discharging holes having gradually reduced hole diameters were arranged from the deepest color portions to the light color portions. Positions corresponding to the lightest color portion were free from the holes).

Shape of the discharging hole : diameter of 0.068 mm

Said fabric was subjected to a dry heat drying treatment at a temperature of 130℃ for a time of 5 minutes, to a high temperature streamer treatment at a temperature of 165℃ for a time of 8 minutes, to a hot water washing treatment and then to a water washing treatment. Thus, the cut pile portion was partially removed by the chemical etching method to obtain the pile fabric in whose cut pile portion a plurality of inclined portions were formed.

In said pile fabric, the inclination angle A, depth difference H, and length W of each of the inclined portions were 2 degree, 0.8 mm, and 10 mm, respectively. In the highest side 40 % region of each of the inclined portions, the number of concaves per unit area was 90 concaves / cm^2, and the rate of the concaves was 2 %. Therefore, the surface of each of the inclined portions scarcely had the fine concaves and the fine convexes and was smooth. Furthermore, along the slopes of the inclined portions, the high places of the cut pile portions are looked in a light color, while the low places of the cut pile portions were shaded and looked in a deep color. The color was gradually changed from the light color to the deep color along the slopes. Hence, the pile fabric was excellent (grade 4) at the point of high grade sense.

[Example 2]

A polyethylene terephthalate multi-filament yarn (yarn count : 56 dtex / 72 filaments, produced by Teijin Fiber (Ltd.)) was thermally treated under conditions comprising a heater length : 2 m, a thermal treatment temperature : 200℃, a thermal treatment speed : 500 m/min, and an overfeed rate : 5 % to obtain the non-crimped polyethylene terephthalate multifilament yarn having a boiling water shrinkage of 3 %.

Separately, a polyethylene terephthalate false-twisted crimped yarn (yarn count : 84 dtex / 36 filaments, a percentage crimp : 25 %, produced by Teijin Fiber (Ltd.)) resin-dyed with a black pigment.

Also separately, a cationic dye-dyeable polyethylene terephthalate (produced by Teijin Fiber (Ltd.)) was melt-spun and wound up at a winding rate of 3,500 m / minutes. The obtained cationic dye-dyeable partially oriented undrawn polyethylene terephthalate yarn was drawn between the 65℃ first roller and the 75℃ second roller of a drawing apparatus at a draw

ratio of 1.4 without thermally setting, thereby obtaining the non-crimped polyethylene terephthalate yarn (yarn count : 56 dtex / 24 filaments) having a boiling water shrinkage of 45 %.

Subsequently, these three yarns were air-mixed by a known interlace nozzle, and the obtained polyester filament mixed yarn (yarn count : 205 dtex / 132 filaments) was used as a yarn for the cut piles of a pile fabric, while a conventional polyethylene terephthalate filament yarn (yarn count : 167 dtex / 48 filaments, a boiling water shrinkage of 10 %, produced by Teijin Fiber (Ltd.)) as a yarn for forming a ground structure. These filament yarns were fed into all the reeds of a tricot warp knitting machine (manufactured by Karl Mayer Corp.) equipped with a pole sinker having 28 gauges, and knitted to obtain the pile knitted fabric having a knit density of 66 courses / 2.54 cm and 28 wales / 2.54 cm.

Structure : back : 10/12, front : 10/01

The obtained loop pile fabric was supplied to a shearing machine (manufactured by Nikki (Ltd.)), and the 0.2 mm tip portions of the loop piles were cut to form the cut piles. The cut pile fabric was supplied to a dry heat setter, and thermally treated at a temperature of 180℃ for a time of 45 seconds to stabilize the non-crimped polyethylene terephthalate multifilament yarns in the cut piles, sufficiently form the crimps of the polyethylene terephthalate multi false-twisted crimped yarns resin-dyed with the pigment, and sufficiently thermally shrink the non-crimped cationic dye-dyeable polyethylene terephthalate yarns.

In such the cut pile fabric, cut piles 2 having the largest cut pile height, cut piles 4 having the lowest cut pile height, and cut piles 3 having the middle cut pile height were formed from the non-crimped polyethylene terephthalate multifilament yarns, the non-crimped cationic dye-dyeable polyethylene terephthalate yarns, and the polyethylene terephthalate multi false-twisted crimped yarns resin-dyed with the pigment, respectively.

The obtained cut pile fabric was dyed with a cationic dye (blue) at 130℃ for 30 minutes by use of a jet dyeing machine manufactured by (Ltd.) Hisaka Seisakusho, dried, and then pre-set to obtain the pile fabric (cut pile density : 129,642 dtex / cm^2) having the cut piles (the height of the cut piles : 2 mm) and having a knit density of 68 courses / 2.54 cm and 30 wales / 2.54

cm. To the obtained pile fabric, applied was the same processing using an alkali-treating agent as in Example 1.

In said pile fabric, formed were the inclined portions as typically shown in Fig. 2, and the inclination angle A, depth difference H, and inclination length W of each of the inclined portions were 2 degree, 0.8 mm, and 10 mm, respectively. In the highest side 40 region of each of the inclined portions, the number of concaves per unit area was 100 concaves / cm^2, and the rate of the concaves was 5 %, and the surface of each of the inclined portions scarcely had fine concaves and fine convexes, and was smooth. The highest portions, middle portions, and lowest portions of the cut pile portion along the slopes of the inclined portions were looked in a white color, a black color, and a black-blue mixed color, respectively. Therefore, the pile fabric was greatly excellent (grade 5) at the point of high grade sense.

[Example 3]

Similarly as in Example 2 except that the number of the rotary screens was changed to 2, the cut pile portion was partially removed by a chemical etching method to obtain the pile fabric in whose cut pile portion the slopes were formed.

In said pile fabric, the inclination angle A, depth difference H, and length W of each of the inclined portions were 2 degree, 0.8 mm, and 10 mm, respectively. In addition, in the highest side 40 % region of each of the inclined portions, the number of concave portions per unit area was 120 concaves / cm^2, and the rate of the concaves was 20 %. Fine concaves and fine convexes were somewhat looked on the surfaces of the inclined portions, but the pile fabric was excellent (grade 4) at the point of high grade sense.

[Example 4]

The pile fabric obtained in Example 2 was color-printed with a usual ink jet. Said fabric subjected to the color-printing had an appearance having good depth and compact inclination differences in response to a looking angle, and was excellent.

[Example 5]

Similarly as in Example 1 except that the discharging amount of each rotary screen was changed to 26.3 cm^3/m^2 and the number of the rotary

screens was changed to 1, the cut pile portion was partially removed by a chemical etching method to obtain the pile fabric in whose cut pile portion the slopes having many fine concaves and convexes were formed.

In said pile fabric, the inclination angle A, depth difference H, and length W of each of the inclined portions were 2 degree, 0.8 mm, and 10 mm, respectively. In addition, in the highest side 40 % region of each of the inclined portions, the number of concave portions per unit area was 150 concaves / cm^2, and the rate of the concaves was 25 %. Fine concaves and convexes were looked on the surfaces of the inclined portions, but the pile fabric was somewhat good (grade 3) at the point of high grade sense.

Industrial applicability

The pile fabric of the present invention can suitably be used in fields such as vehicle interior materials, interior materials, and clothes, and has high practicality, because of having moderate inclined portions on the surface of the cut pile portion and thereby giving rich high grade sense.